DOCUMENT RESUME

ED 109 134 SP 009 400

AUTHOR Ness, R. Gary
TITLE A Comparative Study of the Perceived Stress of Springboard Diving by Age and Sex Groups.
PUB DATE 26 May 75
NOTE 22p.; Study conducted in partial fulfillment of the requirements for a Doctor of Philosophy degree at Stanford University

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Age Groups; Females; Males; *Psychological Patterns; *Stress Variables; *Swimming
IDENTIFIERS *Diving

ABSTRACT

Three measures--physiological, behavioral, and phenomenological in nature--were used to register inexperienced springboard divers' perceptions of stress when faced with the execution of a forward dive from three standard heights; pool deck, one-meter and three-meter springboards. Forty-eight subjects were divided into four groups representing girls, boys, men, and women. Six possible sequences of dives were counterbalanced so that two subjects from each group were randomly assigned to each sequence. Results showed dramatic increases in stress response for all subjects as the height of the dive attempt increased. The ANOVA test for differences in stress response according to sequence of attempts showed no significant differences. Female subjects showed significantly greater stress responses for all three measures. Although younger subjects showed longer hesitation latencies, the differences were not significant. High correlations between performance and phenomenological measures bolstered their reliability as measures of stress. Results suggest a reconsideration of coeducational diving instruction for beginners. (Author/JS)

Manuscript for:

A COMPARATIVE STUDY OF THE PERCEIVED STRESS OF SPRINGBOARD DIVING BY AGE AND SEX GROUPS

May 26, 1975

by

R. Gary Ness, Assistant Professor
of Physical Education
North Texas State University

This study was conducted in partial fulfillment of the requirements for a Doctor of Philosophy degree at Stanford University under the direction of Dr. John Nixon.

Three measures, physiological, behavioral, and phenomenological in nature, were used to register inexperienced springboard divers' perceptions of stress when faced with the execution of a forward dive from three standard heights; pool deck, one-meter and three-meter springboards. Forty-eight subjects were sampled from four populations (n=12) representing girls, boys, men and women. Six possible sequences of dives were counterbalanced so that two subjects from each group were randomly assigned to each sequence. Results showed dramatic increases in stress response for all subjects of the three heights for the three measures of stress. The ANOVA test for differences in stress response according to sequence of attempts showed no significant differences. Female subjects showed significantly greater ($p<.01$) stress responses for all three measures. Although younger subjects showed longer hesitation latencies, the differences were not significant. High correlations between performance and phenomenological measures bolstered their reliability as measures of stress. Results suggest a reconsideration of coeducational diving instruction for beginners.

A student attempting his first forward dive from any given height can expect to experience a certain amount of stress. The possibility of a painful smack on the water has deterred many potential divers, even those who desire very much to learn the skill of springboard diving. Initial dive attempts represent a natural experimental setting for the study of the perception of stress in learning a sports skill involving some risk for subjects of both sexes and all ages. The same setting can address several experimental questions. Does the amount of stress increase with an increase in the height of the dive attempt? Does the sequence in which dive attempts are executed from different heights alter the amount of stress perceived? Do subjects of one sex perceive more stress from the same situation than subjects from the other sex? Does age of the subject make any difference in the magnitude of stress perceived?

Selye (16, 17) first introduced the "stress syndrome" which treated stress response as the sum total of all nonspecific biological phenomena to a known stressor. Central to his concept was the activation of the adrenal glands. Unfortunately, the definition of stress has widened so far that it has become arbitrary just what conditions are stressful to the organism.

The first expansion of the concept of stress occurred when it became apparent that the same biological mechanisms which responded to tissue damage or physical insult also responded when the organism perceived a threat from the external environment. (11, 12) Cognition of a threatening situation, therefore, elicits biological stress responses. McGrath (14) offers an explanation for perhaps the most pervasive form of stress faced in daily living when the individual perceives an imbalance between demand and response capability under conditions where failure to meet demand has important perceived consequences. Because Selye originally focused attention on the endocrine system's role in dealing with stress, confusion developed over the role of emotions in the perception of, and the response to the stressful situation. Lazarus (10) suggests that emotional reactions should be regarded as effects rather than causes, and that these effects, in turn, depend heavily upon cognitive processes.

A logical summation of these insights suggests that a psychological stress study, in order to account for the perception of stress and the individual's coping response, should include objective measures of the amounts of physiological and behavioral responses of the individual as well as a phenomenological (subjective) report of the stress as perceived by the individual. Therefore, this study measured three types of responses to the stress of the diving task: (1) stress felt, in terms of physiological response; (2) stress demonstrated, in terms of a performance measurement; and (3) stress admitted, in terms of a phenomenological self-report. Correlations among the three measurements should enable the diving instructor to more accurately interpret the learner's perceptions from a battery of response cues in the natural stress situation.

Physiologically, the subject's perception of the stress of the diving task was measured indirectly by counting the autonomic sweat activity on the fingertip immediately preceding each dive attempt. Specifically, the number of active sweat glands in a square centimeter of volar skin surface in the central whorl of the fingertip was recorded immediately preceding the dive attempt from each of the three diving heights. The sweat printing technique was borrowed from the work of Sutarman and Thomson (19), Harrison (6) and Dabbs (1) and adapted for the acquatic setting through the use of special plastic impression materials suggested by Harris (5).

The performance measurement was concerned with the execution of a forward dive by the subject from each of the three designated levels. Actually, the subject could do one of three things: dive, jump (feet first entry), or balk (not leave the board). Whatever the subject chose to do was also recorded in terms of the hesitation latency in seconds following a given signal to proceed.

The phenomenological self-report of how much stress the subject experienced in each dive attempt from each level was expressed as a mark on a continuous scale--a paper and pencil response.

Procedures

The subjects engaged for this study were 48 respondents to an offer of free diving lessons in return for participation in an experiment. The respondents were carefully screened to determine that all subjects were known swimmers yet novice divers. Twelve subjects were assigned to each of 4 groups (n-12) according to sex and age. The mean and range for each group is shown in Table 1.

Table 1

Mean Age and Range of Ages for Subject Groups

Group	Mean	Range
Boys	10.11	7.0 to 13.25
Girls	9.96	7.33 to 12.17
Men	29.90	23.92 to 44.33
Women	27.53	19.58 to 39.00

Because there were three different heights of diving for each subject: (1) low, pool deck (12" above water surface); (2) medium, one-meter; and (3) high, three-meters, the order of attempts were counterbalanced into six possible sequences. Of the twelve subjects in each age-sex group, two were randomly assigned to each of the six sequences.

In order to provide a base reading for comparison of palmar sweat responses during stress, a set of prints was taken from each subject, while the subject was at rest and in street clothes, at least 24 hours in advance of his or her participation in the experiment.

The test session for each subject consisted of the attempts from each of the 3 levels with the appropriate measurements. Each session was private, with only the subject and 2 technicians in attendance. The principal technician who was conversant with the subject was always of the same sex as the subject. This step was included to avoid "covert communication" between the experimenter and the subjects of different sex (15). Differences in skin conductance responsiveness in experiments involving experimenters and subjects of different sexes (4) supports the argument that such interaction could exist.

The purpose of the study was read to each subject by the principal technician. A demonstration of the standing forward dive from each of the three levels, in the appropriate sequence for the particular subject was performed by an assistant while the principal technician repeated verbally the teaching points to be followed.

The subject was instructed to approach the end of the springboard (or edge of the pool deck) where the plastic impression material was applied to the last three fingers of the hand opposite his dominant side. Following the application of the paste, the subject was instructed to delay for 2 minutes on the end of the springboard to allow the paste on the fingertips to polymerize (set). When signalled to dive the subject was allowed 60 seconds to leave the board, after which the subject was asked to return to the deck where the measurements would be taken.

If the subject dived or jumped, care was taken by the technician to see that the prints were not destroyed or lost while the subject exited from the pool.

Immediately following each attempt from each level the subject was instructed to pencil a mark on an unnumbered 18 centimeter scale as shown in Figure 1. The resulting mark was subsequently quantified by later measurement from left to right (0 cm. to 18 cm.) on the scale.

not at all afraid _____ "scared stiff"

Figure 1

Self-Report Scale

Results

To assess the amount of stress perceived by inexperienced divers in their initial attempts to dive, three measurements--palmar sweat, self-report, and

Table 2

Means and Standard Deviations for Measures at Each Height by Subject Group

	Girls		Women		Boys		Men	
	$\bar{X}$	(SD)	$\bar{X}$	(SD)	$\bar{X}$	(SD)	$\bar{X}$	(SD)
Sweat Count								
Base	82.3	(115.5)	140.3	(128.4)	64.3	(83.0)	133.7	(122.7)
Low	326.3	(234.7)	315.8	(242.4)	149.2	(224.9)	185.4	(215.9)
Medium	500.5	(261.0)	398.8	(181.0)	240.7	(249.0)	254.6	(213.6)
High	600.6	(190.3)	469.7	(181.5)	326.3	(283.2)	305.4	(209.3)
Self-Report								
Low	4.89	(4.92)	2.43	(5.03)	1.70	(2.27)	1.32	(2.32)
Medium	6.74	(6.56)	6.11	(6.23)	3.05	(2.98)	2.75	(2.12)
High	15.34	(3.86)	14.60	(2.98)	13.12	(3.99)	10.42	(6.27)
Latencies								
Low	22.33	(22.46)	11.08	(16.18)	11.75	(14.79)	5.92	(4.32)
Medium	24.92	(24.76)	21.17	(24.33)	9.33	(6.49)	7.83	(5.86)
High	48.25	(22.55)	36.5	(25.75)	31.33	(21.41)	26.42	(22.56)

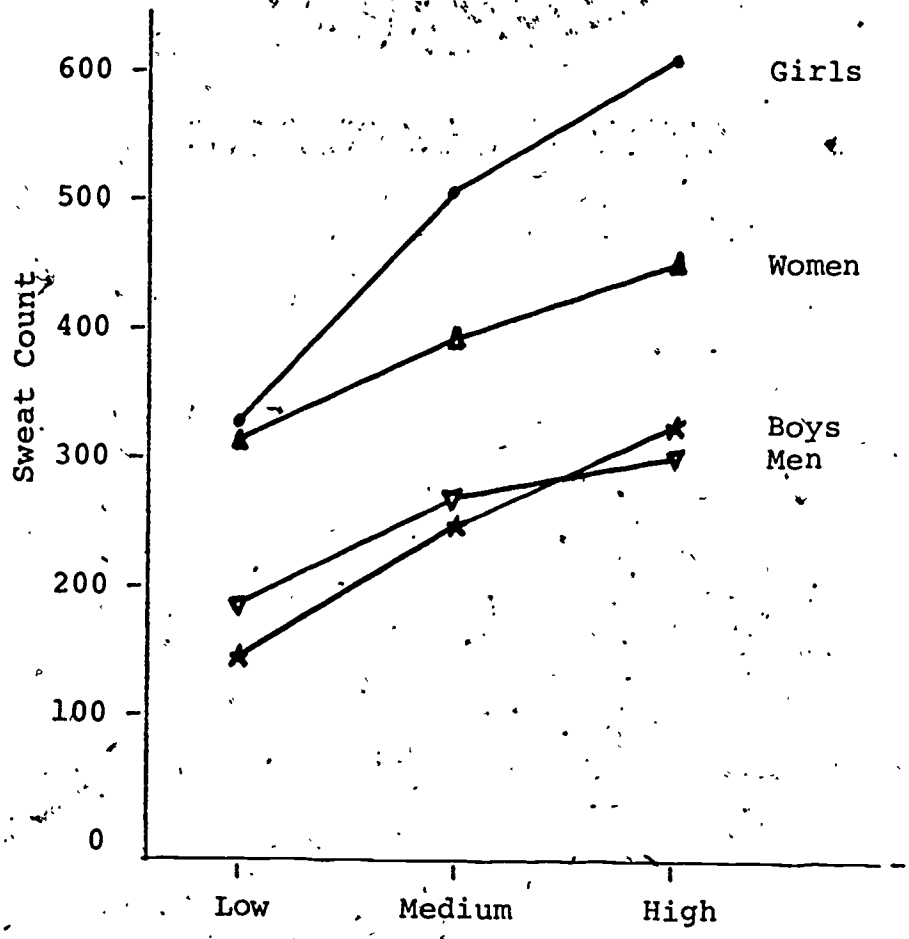

Figure 2

Group Means for Sweat Counts at Each Diving Height

• = Girls

Δ = Women

* = Boys

∇ = Men

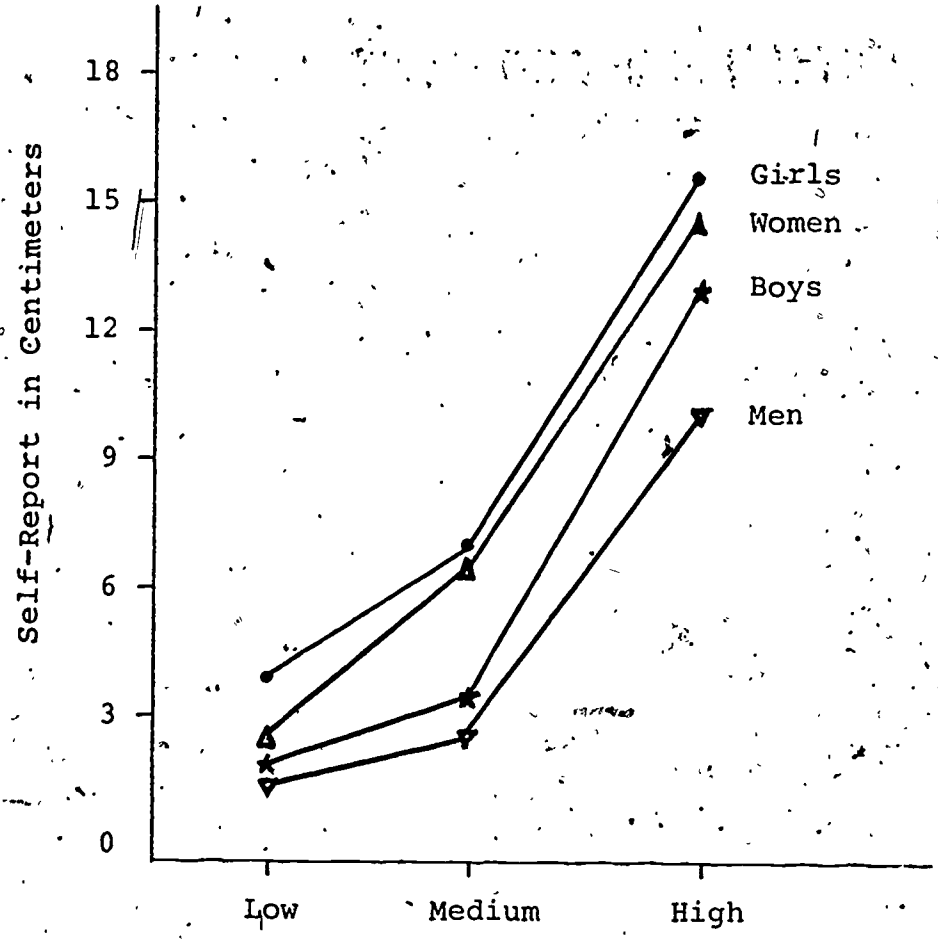

Figure 3

Group Means for Self-Reported Stress at Each Diving Height

• = Girls

Δ = Women

* = Boys

∇ = Men

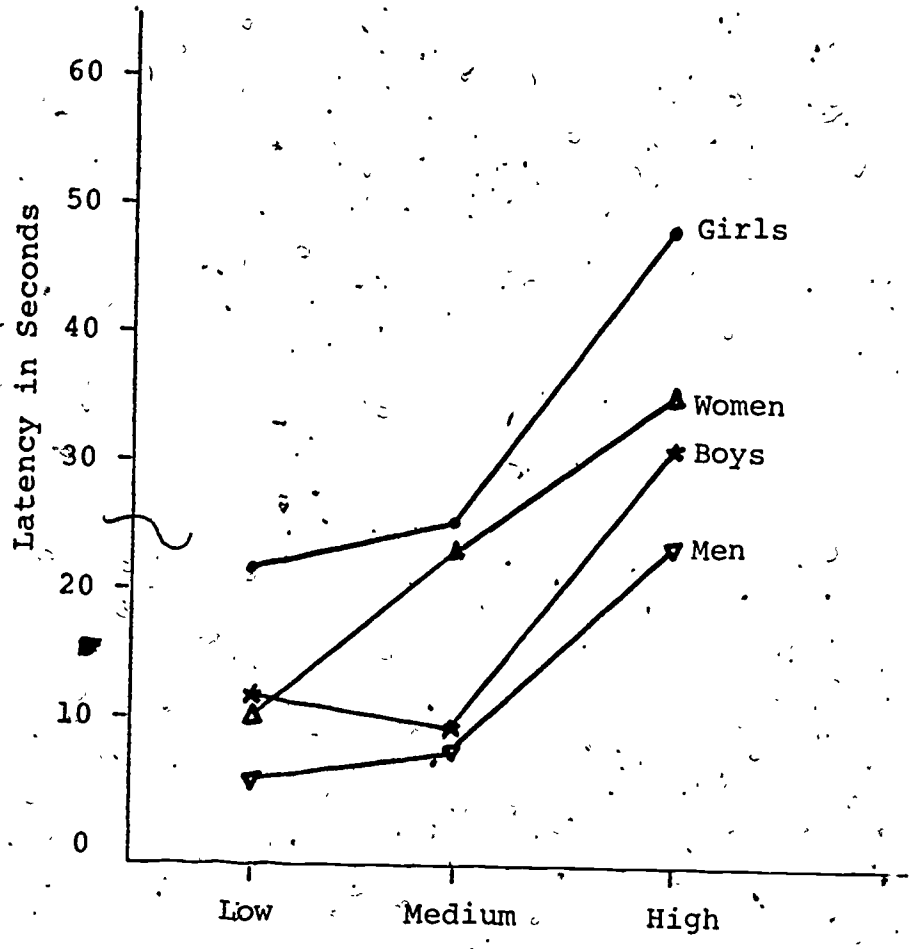

Figure 4

Group Means for Latency at Each Diving Height

• = Girls

Δ = Women

* = Boys

∇ = Men

hesitation latencies--were obtained for all subjects at each of the three diving heights.

As expected, the raw data showed dramatic stress response increases in all three measures as the height of the dive attempt increases. To test the significance of these increases, three-way ANOVA was applied to the data for each measure. F ratios computed on the mean increases were significant ($p < .01$).

To examine the effect of sequence upon the perception of stress, the data for the stress measures were summarized by sequence and subjected to ANOVA. The results showed no significant F ratios. Critical comparisons involving one-meter responses where they followed three-meter attempts using the Tukey "q" statistic (2) did not indicate any significant differences.

In order to examine the main effects of age, sex, height of dive attempt and possible interactions, analysis of variance was performed on the data from the three stress responses. Table 2 summarizes the means and standard deviations of the raw data for all subjects grouped according to girls, boys, men, and women. The mean stress responses for girls are apparently higher than those of the women, and likewise, boys' mean responses exceed those of the men. By sex, however, the females' responses are clearly higher than the male responses. It is worth notice that the lines describing the stress response of each variable maintain some degree of parallelism in Figures 2, 3, and 4.

Tables 3, 4, and 5 summarize the results of a three-way analysis of variance on the raw data for sweat count, self-report, and latency measures, respectively.

For the sweat count measures, Table 3 indicates that the higher counts for females are significantly different than those of males at the .01 level.

Table 3

Analysis of Variance for Sweat Count Measure

Source	SS	df	MS	F
Sex	1323458	1	1323458	12.338*
Age	45546	1	45546	0.4246
Sex x Age	74483	1	74483	0.6944
Subjects within Sex x Age	4,719,753	44	107267	($*F_{1,44,.99} = 7.24$)
Height	795329	2	397664.5	17.3291*
Sex x Height	27752	2	13881	0.6049
Age x Height	48483	2	24241.5	1.0564
Sex x Age x Height	8858	2	4429	0.1930
Residual	2,019,409	88	22947.83	($*F_{2,88,.99} = 4.88$)

*Significant at .01 level.

Table 4

Analysis of Variance for Self-Report Measure

Source	SS	df	MS	F
Sex	315.36	1	315.36	9.5246*
Age	52.20	1	52.20	1.5766
Sex x Age	0.21	1	0.21	0.0063
Subjects within Sex x Age	1456.79	44	33.11	($F_{1,44,.99}$ = 7.24)
Height	3143.12	2	1571.56	123.6184*
Sex x Height	12.44	2	6.22	0.4893
Age x Height	10.33	2	5.16	0.4063
Sex x Age x Height	24.64	2	12.32	0.9692
Residual	1118.74	88	12.71	($F_{2,88,.99}$ = 4.88)

*Significant at .01 level.

Table 5

Analysis of Variance for Latency Measure

Source	SS	df	MS	F
Sex	5136.1	1	5136.1	7.4566*
Age	1521.0	1	1521.0	2.2082
Sex x Age	210.3	1	210.3	0.3053
Subjects within Sex x Age	30307.2	44	688.8	($F_{1,44,.99}$ = 7.24)
Height	14785.6	2	7392.8	35.4481*
Sex x Height	303.6	2	151.8	0.7278
Age x Height	270.6	2	135.3	0.6486
Sex x Age x Height	33.0	2	16.5	0.0792
Residual	18352.6	88	208.6	($F_{2,88,.99}$ = 4.88)

*Significant at .01 level.

For self-report measures, Table 4 indicates significantly ($p<.01$) higher self-report responses for females than for males. The apparent age differences, however, were not significant ($p>.05$). No significant second order or three-factor interactions were found.

For latency measures, Table 5 reveals significantly ($p<.01$) longer hesitations for female subjects than for male subjects. Figure 4 shows that although younger subjects waited longer, the latency differences were not significant ($p>.05$). The interaction suggested in Figure 4 between groups did not test significant.

Table 6 indicates the Pearson correlations coefficents for measures at each of the three heights. The apparent high ($r=.5$ or more) intermeasure correlations between self-report and latency measures serve as reliability coefficents for both measures, lending credence to the fact that the same response was indeed being measured. The sweat count measure, although correlating well within itself for the three heights, did not correlate highly with the other measures. This appears to be the result of rather large within subject variances for the sweat count measure. Correlations between physiological and non-physiological stress measures have characteristically been low in other investigations (9, 13).

The performance of each subject to the diving task was classified accordingly: (1) dive; subject dived, head-first; (2) jump; subject dived, feet-first; (3) balk-before; subject did not leave the board and was pre-disposed not to dive before he or she ever stood on the springboard; and (4) balk-after; subject discovered after reaching the end of the springboard that he or she could not bring himself or herself to leave it. Intuitively, the amount of stress perceived should be slightest for the subject who dives, heavier for the subject

Table 6

Correlations Between Measures of Stress

Measures		2	3	4	5	6	7	8	9	10
Base Sweat	1	39	23	10	33	31	22	26	-21	-12
Pl Deck Sweat	2		34	13	67	43	26	61	01	24
Pl Deck Self-Report	3			71	38	61	49	23	23	30
Pl Deck Latency	4				32	38	63	27	26	43
One-meter Sweat	5					32	38	58	13	22
One meter Self-Report	6						63	30	40	31
One-meter Latency	7							38	10	52
Three-meter Sweat	8								-06	26
Three-meter Self-Report	9									28
Three-meter Latency	10									

Note: Decimal points dropped in correlations.

who jumps (if, indeed, jumping is a compromise between diving and doing nothing), more for the subject who balked, even if the decision was made before approaching the springboard, and the stress should be greatest on the subject who cannot quite perform the dive.

The three-meter dive attempt offers the best opportunity for scrutiny of stress measures by performance. ANOVA performed on the average of each measure over the three heights and regrouped according to the performance variable revealed significant ($p<.05$) F ratios for average sweat counts and average self-report. Contrary to the intuitive proposition, balk-before responses were greater than balk-after responses. That is to say, the strongest average stress responses came from those who decided on the ground that they could not dive from the three-meter board. The ad hoc Sheffe method (3) of multiple comparison for groups with unequal n's was employed using the .10 and .05 levels of significance to test individual and multiple mean differences between performance groups. The only significant ($p<.05$) comparison was the mean differences between those subjects who balked while being predisposed not to dive and those subjects who dived. All other comparisons yielded nothing significant, even at the .10 level. For the average self-report measure, the samecomparison (balk-before and divers) revealed a significant ($p<.05$) ratio. The combined balk-beforeand balk-after responses yielded a significant ratio ($p<.05$) when compared to the combined dive and jump group measures.

DISCUSSION

The findings of this study revealed significant differences in the three modes of stress responses--sweat counts, self-reports, and hesitation latencies--when analyzed over heights by three-way ANOVA. As the height of the dive attempt increased, the stress responses increased significantly ($p<.01$).

The strong and consistently increased palmar sweating did not reveal what might be expected on the basis of previous research (1, 7, 8) in which both increases and decreases of palmar sweating were found in subjects' responses to different stressors. Theoretically, Dabbs, et al. (1) claimed that increased palmar sweating reflected feelings of arousal or situations where the subject is ready to interact with the environment, whereas the anhydrotic effect is expected when the subject's attentions are directed toward his own feelings and away from the activity around him. Since both situations were possible for the diver in this study, variations in sweat counts across individuals were expected. However, the very consistent increase of sweat counts was maintained for the forty-eight subjects.

The sequence of dive attempts from the three heights was investigated for differences in stress response to attempts for each height in a particular sequence. That significant differences in strength of stress response according to sequence of attempts were not found is surprising in light of seemingly universal preference of learners to attempt dives from lower heights first. The findings of this study, however, simply do not support any notion that sequence of initial dive attempts makes any differences to the strength of stress response displayed by the diver at any given height.

In order to examine the effects of the attribute variables age and sex in the stress response to initial attempts to dive from each height, analysis of variance was performed on the data for sweat counts, self-reports, and latency responses. The observed differences in magnitude of stress for females was significantly higher ($p<.01$) for stress responses on each of the three measures. The observed response differences for the age variable were not significant ($p>.05$) for any measure. Therefore, diving instructors can

reasonably expect female students to exhibit greater stress than male subjects to diving from various heights for the first time. The results from this study suggest a reconsideration of coed classes for beginning divers. If the female student can be expected to feel more stress and to take longer to attempt initial dives, then classes composed of students of the same sex could be expected to begin learning at a more compatible rate. The instructor for the beginners' class could direct his plans for learning tasks and progressions to a more compatible group of students. If the beginning classes remain coed, the instructor should manipulate the learning tasks and/or the learning environment to balance the expected responses of both sexes.

Results of subjects' preformance on and from the springboard showed dramatic increases in the number of subjects who balked at greater heights. The surprising result is that the strongest average stress responses came from those subjects who decided on the ground that they could not dive from the given height. This can be interpreted as saying that those who demonstrated the strongest fear of diving brought this fear with them, i.e., the fear was preconceived. Those who decided they could not dive after experiencing the stress at the location of the dive showed almost as much stress. Diving instructors, therefore, would be wise not to force or pressure learners who are reluctant to approach the diving station.

References

1. Dabbs, James M. Jean E. Johnson, and Howard Leventhal. "Palmar Sweating; A Quick and Simple Measure." Journal of Experimental Psychology, 78:2 (1968), 374-350.

2. Dixon, W. J. and F. J. Massey, Jr. Introduction to Statistical Analysis. New York: McGraw-Hill Book Company, 1969.

3. Ferguson, Geroge A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, 1971.

4. Fisher, Leslie E. and Harry Kotses. "Experimenter and Subject Sex Effects in the Skin Conductance Response," Psychophysiology, 11:2 (1974), 191.

5. Harris, David, G. Frank Polk, and Issac Willis. "Evaluating Sweat Gland Activity with Imprint Techniques." Journal of Investigative Dermatology, 59:2 (1972), 78.

6. Harrison, J. "The Behavior of the Palmar Sweat Glands in Stress," Journal of Psychosomatic Research, 8 (1964), 187.

7. Harrison, J., R.C.B. MacKinnon, and M.E. Monk-Jones. "Behavior of the Palmar Sweat Glands Before and After Operation," Clincial Science, 23 (1962), 371-377.

8. Harrison, J. and P.C.B. MacKinnon, "Physiological Role of the Adrenal Medulla in the Palmar Anhidrotic Response to Stress," Journal of Applied Physiology. 21 (January, 1966), 88-92.

9. Lacey, J. I., Dorothy E. Bateman, and Ruth Van Lehn. "Autonomic Response Specificity: An Experimental Study." Psychosomatic Medicine, 15 (1953), 8-21.

10. Lazarus, Richard S. "Cognitive and Personality Factors Underlying Threat and Coping," in Sol Levine and Norman Scotch (eds.), Social Stress. Chicago: Aldine Publishing Co., 1970, p. 145.

11. Levine, Seymour and David Treiman. "Determinants of Individual Differences in the Steroid Response to Stress." in E. Bajusz (ed.), Physiology and Pathology of Adaptation Mechanisms. New York: Pergamon Press, 1969.

12. Levine, Seymour, Larry Goldman, and Gary D. Coover. "Expectancy and the Pituitary-Adrenal System," Ciba Foundation Symposium 8, ASP (1972).

13. Mandler, G., J. M. Mandler, I. Kremen, and R. Sholiton. "The Response to Threat: Relations Among Verbal and Physiological Indices," Psychological Monographs, 75 (1961) (9, Whole No. 513).

14. McGrath, Joseph E. Social and Psychological Factors in Stress. New York: Holt, Rinehart & Winston, 1970.

15. Rosenthal, Robert. "Covert Communication in the Psychological Experiment," Psychological Bulletin, 67 (1967), 356-367.

16. Selye, Hans. The Physiology and Pathology of Exposure to Stress. Montreal: Acta, Inc., Medical Publishers, 1950.

17. Selye, Hans. The Story of the Adaptation Syndrome. Montreal: Acta, 1952.

18. Sutarman, and M. L. Thomason. "A New Technique for Enumerating Active Sweat Glands in Man," Journal of Physiology, 117 (1952), 61 p.